

of these two types with respect to the arrangement of the leaves. The Huntingdon elm (*U. vegeta*), commonly believed to be a hybrid, produced 732 opposite-leaved seedlings and 239 alternate-leaved, the expected Mendelian result if the Huntingdon elm is an F_1 hybrid between *U. glabra* and *U. montana*. Other ratios given by different varieties were 245:95 and 310:84, when the parent trees had grown in such situations that their pollination was probably effected by pollen from the same variety. The progeny of a "Jersey" elm, which was probably pollinated by *U. montana*, consisted of 17 opposite-leaved and 19 alternate-leaved, equality probably being "expected." The "English" elm (*U. campestris*) is also an undoubted hybrid, but this rarely produces fertile seeds, though an abundance of samarae are produced; 19 boxes of seeds of the English elm gave no germinations. This sterility and also the appearance of many imperfect flowers in the various cultivated varieties are accepted by the author as additional evidences of hybridity. The author believes that the varieties produced in genera having a number of species are of fundamentally different nature from those in genera including a single species. In birch, oak, lime, poplar, and willow, as in elm, the varieties are hardly to be distinguished from distinct species except by breeding tests. They are generally the result of hybridization, while in the beech and the ash, each of which is represented in northern Europe by a single species, the numerous varieties are of the nature of "sports," whose relationship and varietal value are recognized at once, as in the case of cut-leaved, purple-leaved, weeping varieties, etc.—GEO. H. SHULL.

Geotropism.—ZIELENSKI,¹³ working in JOST's laboratory, has made accurate determinations of presentation, reaction, and critical times, and of the relaxation index in geotropism, using the roots of *Lupinus albus* and *Lepidium sativum*. Use of the clinostat and horizontal microscope renders his methods delicate and accurate, and the paper has the appearance of a real contribution. "Reaction time" is the period (under continual exposure) from the beginning of horizontal placement to the beginning of curvature. "Presentation time" is the least continual horizontal exposure necessary to give curvature at some later time (the organ is on an equally rotating horizontal clinostat from end of exposure to beginning of reaction). "Critical time" is the least exposure that is not entirely nulled by an opposite and immediately following exposure of equal length (organs are on a horizontal equally rotating clinostat after the second exposure). "Relaxation index" is the ratio of the length of the equal individual rotation periods to the length of equal individual exposures (shorter than presentation time), that will not result in summation. Reaction, presentation, and critical times were determined

¹³ ZIELENSKI, FELIX, Ueber die gegenseitige Abhängigkeit geotropischer Reizmomente. Zeitschr. Bot. 3:81-101. 1911.

by reaction in more than half the roots, and relaxation index by reaction in fewer than half. The accompanying table from the article summarizes the results:

	Presentation time	Critical time	Reaction time	Relaxation index
Lepidium sativum at 17-18C. . .	5.5 min.	6 min.	25.5 min.	30
“ “ at 25-27C. . .	1.5 “	2 “	12.5 “	40
Lupinus albus at 17-18C. . .	8.5 “	11 “	46.5 “	20
“ “ at 25-27C. . .	2.0 “	7 “	33.0 “	25

One is struck here by the time demanded for relaxation from an exposure; it is very much greater than reported by FITTING. The author attempted, without full success, to develop a formula by which any one of the critical periods can be calculated from the other three.—WILLIAM CROCKER.

Photosynthesis.—LUBIMENKO¹⁴ finds that there is a light optimum for the production of dry substance by green plants. The absolute value of this optimum is less than that by which the chlorophyll apparatus is able to furnish the maximum of photochemical work expressed in the decomposition of CO₂. By means of monochromatic filters and gasometric determinations, a comparison is made of the action of the different colored rays on the decomposition of CO₂. These results are compared with the action of the same rays on the production of total dry weight. The energy for CO₂ decomposition in colored light depends upon the absorption of the various colored rays by the chloroplasts as well as on their caloric energy. The author objects to the method employed by KNIEP and MINDER and others in determining the influence of different colored rays on CO₂ assimilation, on the ground that they measured the quantity of light falling upon the leaf and not that absorbed by the chloroplasts. The real carbon fixation expressed by the increase in dry weight is influenced unequally by the different colored rays. The maximum increase in dry weight occurs under the action of the blue-violet rays. The yellow-orange rays are inferior to the red rays, and the minimum occurs in the green rays. It is necessary to assume two successive stages in the photosynthetic process. The first is characterized by the decomposition of CO₂ and synthesis of the first organic product. In this stage of the process the plant utilizes predominantly the energy of the red rays of the solar spectrum. The second stage is characterized by the definitive fixation of the first organic product, and the plant employs for this work especially the blue-violet rays.—CHAS. O. APPLEMAN.

¹⁴ LUBIMENKO, M. W., L'assimilation chlorophyllienne et la production de substance seche à la lumière blanche et à la lumière colorée. Rev. Gén. Bot. 23:1-14. 1911.